

Monitors

This chapter presents the PC 99 requirements and recommendations for display monitors.

Requirements for graphics adapters and television output capabilities are defined in the “Graphics Adapters” chapter in Part 4 of this guide.

Mobile PC Note

For issues related to liquid crystal displays (LCDs), see the “Mobile PC 99” chapter in Part 2 of this guide.

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Design Note for Dot-Pitch Limits

Dot-pitch requirements are not specified for PC 99 because dot pitch depends on resolution and size. Also, design features other than dot pitch contribute to usability for PC applications, such as focus and phosphor. However, the following table defines limits based on monitor size.

800 × 600 Dot-Pitch Limits

Monitor size (inches)	Actual size (inches)	Horizontal size (inches)	Vertical size (inches)	Maximum dot pitch (mm)
13.00	11.74	9.39	7.04	0.30
14.00	12.72	10.18	7.63	0.32
15.00	13.70	10.96	8.22	0.35
17.00	15.66	12.53	9.40	0.40
21.00	19.58	15.66	11.75	0.50
25.00	23.50	18.80	14.10	0.60
27.00	25.46	20.37	15.28	0.65
31.00	29.38	23.50	17.63	0.75
33.00	31.34	25.07	18.80	0.80
35.00	33.30	26.64	19.98	0.85
37.00	35.26	28.21	21.16	0.90

Monitor Basic Features

This section summarizes the basic PC 99 design requirements for mobile, desktop, and entertainment monitors.

1. Color monitor is DDC2B-compliant with unique EDID identifier

Required

A monitor designed for or included with a PC 99 system must be compliant with *Display Data Channel Standard, Version 3.0, Level 2B protocols* (DDC2B), which defines the communications channel between the display and host system.

The monitor also must transmit an EDID structure containing unique ID Manufacturer Name and ID Product Code identifiers, plus all required fields as defined in Section 3 of *Extended Display Identification Data Standard, Version 3.0* or later.

Mobile PC Note

Mobile computers do not need to support DDC between the graphics adapter and the display if both are in the same enclosure.

The order for the timing information in the EDID structure should be:

1. Preferred mode detailed timing (first detailed timing listed when preferred mode bit is set).
2. Other detailed timings.
3. Timing based on GTF, if GTF support is explicitly indicated in EDID.
4. Standard timings.
5. GTF-generated timings (when items 1–4 above do not apply).

2. Monitor supports ICC color matching

Required

Windows and Windows NT support using color profiles that comply with the International Color Consortium (ICC) Profile Format specification. The Image Color Matching (ICM) APIs and functionality for Windows and Windows NT are described in the Win32 SDK and the Windows NT 5.0 DDK.

For PC 99, color-capable devices such as desktop monitors, printers, scanners, still-image cameras, LCDs, color plasma displays, or other flat-panel devices are required to install one or more ICC profiles for ICC color matching. A monitor color-calibration utility is recommended for generating, editing, and installing ICC profiles. The sRGB profile will be distributed in Windows and Windows NT.

Mobile PC Note

This is also a PC 99 requirement for LCDs, color plasma displays, and other flat-panel devices.

3. Monitor meets all PC 99 general device and driver requirements

Required

This includes the basic requirements for a Plug and Play device ID, automated software-only settings for device configuration, device drivers and Windows-based installation, and icons for external connectors. For more information, see the “PC 99 Basic Requirements” chapter in Part 2 of this guide.

The manufacturer does not need to supply a driver if a PC 99-compliant driver provided with the operating system can be used. If the manufacturer supplies a driver, the requirements for the device driver and installation are defined in the “PC 99 Basic Requirements” chapter in Part 2 of this guide. The PC 99 requirements include driver support for unattended installation and Help file support if special driver parameters are used.

Note: Monitor support for Windows is installed using a monitor INF file, as defined in the Windows and Windows NT DDKs.

4. Monitor supports a mechanism for control from host software*Recommended*~~*Required*~~

The control of brightness, contrast, screen offset, etc. should be controllable from host software. This is best accomplished using either ~~USB or DDC2B (Display Data Channel Standard, Version 3.0, Level 2B protocols) methods.~~

The control of things like picture offset is important as sometimes the system will need to switch between desktop refresh rates and video refresh rates to optimize video playback. Software control is also important for, as an example, infra red remote control applications.

Digital monitor implements a VESA Plug and Display digital interface

We would like to promote the use of the future VESA Plug and Display standard to define a suitable base-line feature set. On a digital monitor it is not necessary to implement the analog VGA signals or the IEEE 1394 signals from the Plug and Display standard, but the digital VGA interface and other connections such as DDC should be implemented. The specific requirements will be detailed in the base-line VESA Plug and Display specification.

Desktop Monitor Requirements

This section lists the PC 99 hardware requirements and features for desktop monitors.

5. Monitor meets minimum graphics resolution, based on monitor size*Required*

With the following higher resolutions, a larger desktop area can be displayed, more applications can be shown on the display at once, individual windows can be larger, applications can be fully displayed side by side, and so on.

- 14-inch to 15-inch external monitor or built-in mobile PC display = 800 × 600, non-interlaced
- 17-inch external monitor or 13-inch to 15-inch LCD = 1024 × 768, non-interlaced
- 19-inch to 21-inch monitor = 1280 × 1024, non-interlaced

Note: These specific monitor sizes are not listed as recommended or required; they merely show the expected resolution.

6. CRT-based monitor supports ergonomic timing standards*Required*

Recommended: 85 Hz for 1024 × 768.

The monitor must, at a minimum, support the ergonomic timings documented in *VESA and Industry Standards and Guidelines for Computer Display Monitor Timing Version 1.0, Revision 0.6-7* or later, for all resolutions supported by the

monitor (based on monitor size, as cited earlier in this section). The standards ensure a clear, flicker-free display for traditional PC computing.

7. CRT-based monitor synchronizes to a new format in a timely fashion

Required

When the scanning rate into the monitor is changed from one of its valid rates to another valid rate, it must resynchronize to the new format and produce a stable picture within three seconds of the new timing from the graphics card becoming stable.

This capability is important because it will sometimes be necessary to change from high refresh-rate graphics modes to 60-Hz modes in order to optimize video playback.

It is recommended that the monitor is designed to minimize the number of strange noises it produces as it transitions between rates, because this can be alarming to some users.

This requirement might be ~~increased~~ tightened in future versions of these guidelines.

Entertainment Monitor Requirements

The Entertainment PC system requires a picture tube ideal for both PC graphics and television/movie video. This section defines the requirements for large-screen entertainment monitors.

Although an entertainment monitor is not required for Entertainment PC 99, a large-screen monitor that is sold with an Entertainment PC 99 system must meet the requirements defined in this section.

8. Large-screen monitor is 20 inches (viewable diagonal) or larger if included with an Entertainment PC system

Required

Recommended: 31 inches or 33 inches, measured on the diagonal.

9. Entertainment monitor supports 800 × 600 at 60 Hz refresh rate

Required

Recommended refresh rate: 60 Hz for North America. Various rates are appropriate for Europe, such as 50, 60, or 75 Hz, depending on the video processing capabilities of the host PC.

It is acceptable to use 60 Hz in North America, because these types of monitor are intended to be viewed from at least a 6-foot distance, thus avoiding excessive flicker. Keeping the rate the same as the native video source will result in the best video quality because of the jitter problems associated with using linear video processing to change refresh rates.

A display format of 800×600 at 60 Hz progressive (or the wide-screen equivalent) requires a refresh rate of about 38 kHz. This rate is commonly available in CRT-based large-screen TV-style monitors. A display format of 1024×768 at 60 Hz progressive (or the wide-screen equivalent) is preferable but requires a scan rate of around 47 kHz. With the advent of good scaling on graphics adapters and program-enhancing additional data services, good use can be made of the higher resolution if it is available.

10. Entertainment monitor's host control has digitally controlled geometry

Recommended

The host control of the monitor should be ~~managed~~ accomplished using DDC2B or ~~USB-compatible adapters and drivers~~.

Geometry control is necessary for adjustment of PC television images and includes the following controls: skew, pin cushion, size, brightness, contrast, and position. If implemented, geometry control must be provided through a software application rather than through dials on the monitor case. Controls must be revealed through a driver with a remote-controllable user interface.

Plug and Play Design for Monitors

The items in this section summarize PC 99 requirements for Plug and Play.

11. External monitor meets DDC2B and EDID standards

Required

This requirement is based on DDC2B, which defines the communications channel between the display and host system, and on the EDID standard, which defines data formats for configuration information. This requirement includes the identification string and other EDID data that the monitor sends to the system.

Use the established standard or (if necessary) detailed timings to indicate the maximum resolution that the monitor will support. Using either the established or standard timings will result in greater flexibility when using detailed timing descriptor blocks.

The following items are particularly critical:

- EDID content must indicate the complete range of the monitor's capabilities.
Do not use the EDID to indicate only the preset modes that the monitor supports. Take advantage of the established and standard timings to include as much information about the monitor's capabilities as possible.
- At least one piece of information must indicate the maximum resolution plus maximum timing at that resolution supported by the monitor.
If this is not implemented using the established or standards timings, then a detailed timing can be used.

To enhance the Plug and Play functionality of monitors, the following monitor descriptor definitions are strongly recommended, as defined in the VESA EDID standard (and currently listed in item #10 *PC 98 System Design Guide*):

- **FD (monitor range).** This information is essential for enabling the operating system to calculate the optimal refresh rate for any selected resolution.
- **FC (monitor name).** Up to three detailed timing blocks can be used to incorporate the company and model name. These descriptors will be concatenated for a single string, and the blocks must be used in the order in which they are to be concatenated.
- **FF (monitor serial number).** If provided, this information will be placed into the registry for easy access by asset-management software.

Power Management for Monitors

This section summarizes the specific power management requirements for monitors.

12. Monitor complies with device class power management reference specification

Required

The *Display Device Class Power Management Reference Specification, Version 1.0* or later, provides definitions of the OnNow device power states (D0–D3) for graphics adapters and monitors. The specification also covers device functionality expected in each power state and the possible wake-up event definitions for the class, if any. CRT Monitors must support the D0, D2, and D3 power states. The D1 power state is optional for monitors.

Mobile PC Note

Flat panel displays can implement just two states, that is, on or off.

Monitors References

The following represents some of the references, services, and tools available to help build hardware that is optimized to work with Windows operating systems.

| *Display Data Channel Standard, Version 3.0, Level 2B protocols*~~Level B~~
(includes VBE/DDC)

Extended Display Identification Data (EDID) Standard, Version 3.0

VESA and Industry Standards and Guidelines for Computer Display

Monitor Timing, Version 1.0, Revision 0.6

Video Electronics Standards Association (VESA)

2150 North First Street, Suite 440

San Jose, CA 95131-2029 USA

Phone: (408) 435-0333

Fax: (408) 435-8225

<http://www.vesa.org>

Display Device Class Power Management Reference Specification, Version 1.0

<http://www.microsoft.com/hwdev/onnow.htm>

International Color Consortium

ICC Profile Format specification

<http://www.color.org>

Universal Serial Bus Monitor Control Class Specification, Version 1.0

Phone: (503) 264-0590

Fax: (503) 693-7975

<http://www.usb.org>

Windows NT DDK, Windows DDK, DirectX DDK, and Microsoft Platform SDK

MSDN Professional membership

Checklist for Monitors

If a recommended feature is implemented, it must meet the PC 99 requirements for that feature as defined in this document.

1. Color monitor is DDC2B-compliant with unique EDID identifier
Required
2. Monitor supports ICC color matching
Required
3. Monitor meets all PC 99 general device and driver requirements
Required
4. Monitor supports a mechanism for control from host software
Required
5. Monitor meets minimum graphics resolution, based on monitor size
Required
6. CRT-based monitor supports ergonomic timing standards
Required
7. CRT-based monitor synchronizes to a new format in a timely fashion
Required
8. Large-screen monitor is 20 inches (viewable diagonal) or larger if included with an Entertainment PC system
Required
9. Entertainment monitor supports 800 × 600 at 60 Hz refresh rate
Required
10. Entertainment monitor's host control has digitally controlled geometry
Recommended
11. External monitor meets DDC2B and EDID standards
Required
12. Monitor complies with device class power management reference specification
Required